Problem Set Answer Key
HST.021 Musculoskeletal Pathophysiology

1.

$W = mg$

$|F_{AB}x| = |F_{AB}| \sin 30^o$, $|F_{AB}y| = |F_{AB}| \cos 30^o$

$F_j = F_{jx}x + F_{jy}y$

$\Sigma Fx = 0 = -F_{AB}x + F_jx \quad (1)$

$\Sigma Fy = 0 = -F_{AB}y + F_jy - 5W/6 \quad (2)$

$\Sigma M = 0 = r \times F = rF\sin\theta$

$M_o = 0 = b(5W/6) \sin(-90^o) + aF_{AB} \sin(90^o) \quad (3)$

From (1), $F_jx = F_{AB} \sin 30^o$

From (2), $F_jy = F_{AB} \cos 30^o + 5W/6$

From (3), $F_{AB} = b(5W/6) = (15 \text{ cm})(5/6)(60 \text{ kg})(9.8 \text{ m/s}^2)/5 \text{ cm}$

$F_{AB} = 1470$ N

$F_jx = (1470 \text{ N}) \sin 30^o = 735$ N

$F_jy = (1470 \text{ N}) \cos 30^o + (5/6)(60 \text{ kg})(9.8 \text{ m/s}^2) = 1763$ N

$F_j = (735 \text{ N})x + (1763 \text{ N})y = 1910$ N, $\theta = 67.4^o$

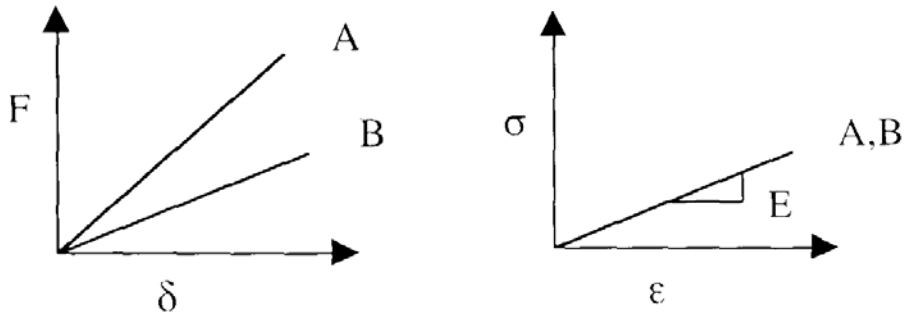
2.

Osteoblast	**Osteoclast**
a) mesenchymal	a) monocyte/macrophage
b) bone deposition	b) resorption
c) PTH, IGF, estrogen, PTH-P, IL-1, IL-6, PDGF, vitamin D	c) calcitonin, some PTH, IL-6, integrins
d) mitochondria, vesicles, ER, single nucleus	d) multinucleated, proton pumps, microvilli, lysosomes
e) osteoporosis type II, from a reduction in osteoblasts	e) Paget's osteopororsis type I, from a loss of estrogen leading to an increase in osteoclasts.

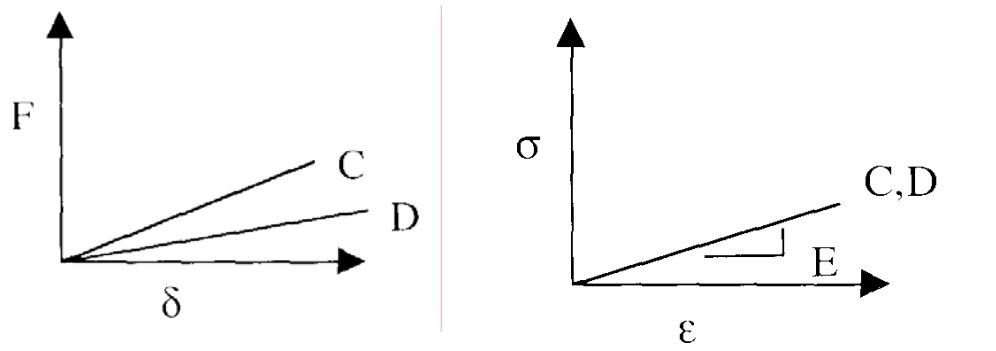
3.

a) $k = AE/L$ = structural stiffness
$E = (FL)/(A\Delta L)$ = material stiffness
$F = EA(\Delta L/L) = k\Delta L$
$\delta = E\varepsilon$ (independent of geometry)
→ per unit area, per unit length

b)



c)



4.

a) $k = AE/L$

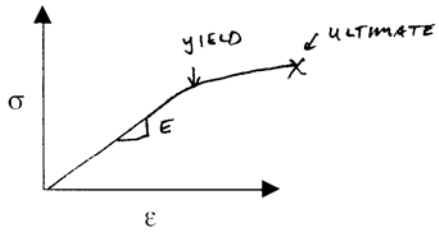
b) An increase in A would increase the stiffness where as increase in the length would decrease the stiffness

c) $\sigma = F/A$

$\varepsilon = \Delta L/L$

$F = AE(\Delta L/L) \rightarrow F/A = E(\Delta L/L) \rightarrow \sigma = E\varepsilon$

d)



yield stress and strain define the point at which permanent deformation occur

ultimate stress and strain define the point at which failure occurs.